

What is claimed is:

1. A retractable lens barrel comprising:

a rear holder configured to hold a first optical element along an axis, the rear holder being movable along  
5 said axis between an operational position and a retracted position;

an annular member movable along the axis towards and away from said rear holder without rotation;

a retractable holder, at least partially  
10 accommodated within the annular member, configured to hold a second optical element, the retractable holder being movable between an aligned position where the second optical element is aligned with said axis and a displaced position where the second optical element is displaced  
15 relative to the axis;

a position control device configured to control said annular member and retractable holder to move between an operational position spaced from said rear holder with said retractable holder at said aligned position to a  
20 retracted position where said first optical element is accommodated within an inner peripheral surface of the annular member with said retractable holder at said displaced position and where a portion of said rear holder and a portion of said retractable holder are at  
25 substantially the same position on said annular member

axis;

said rear holder and said retractable holder comprising respective contact surfaces configured to contact each other only if movement of said annular member and retractable holder to said retracted position occurs  
5 and the rear holder has not fully moved to the retracted position thereof.

2. The retractable lens barrel according to claim 1, wherein a movement path of said retractable holder  
10 includes an oblique path extending obliquely to said axis.

3. The retractable lens barrel according to claim 1, wherein the contact surface of said rear holder is inclined to a plane substantially orthogonal to said axis.

4. The retractable lens barrel according to claim  
15 1, wherein said rear holder is a substantially rectangular shape and includes a front end surface and four side surfaces which extend rearward from said front end surface to surround said axis;

wherein the contact surface of the rear holder  
20 comprises a rib-like projecting portion located on said front end surface.

5. The retractable lens barrel according to claim 4, further comprising:

at least one guide shaft located outside said  
25 annular member and extending substantially parallel to

said axis; and

wherein said rear holder includes at least one radial arm portion which projects radially outwards from said rear holder, said rear holder configured to be guided  
5 by said at least one guide shaft in said axis direction.

6. The retractable lens barrel according to claim 5, wherein said rear holder comprises a pair of radial arm portions which project radially outwards in substantially opposite directions away from each other;  
10 and

a pair of guide shafts configured to respectively guide said pair of radial arm portions.

7. The retractable lens barrel according to claim 1, further comprising:

15 a stopper located on a side of the rear holder remote from said annular member and which is configured to set a movement limit of said rear holder; and

a controller configured to control movement of said rear holder to said movement limit before commencement  
20 of movement of said annular member and retractable holder from said operational position to said retracted position.

8. The retractable lens barrel according to claim 1, wherein said retractable holder comprises a swingable  
25 member which is rotatably supported on a pivot

substantially parallel to said support member axis to be swingable about said pivot.

9. The retractable lens barrel according to claim 8, wherein said retractable holder comprises:

5 a cylindrical lens holder portion configured to hold the second optical element;

a swing arm portion projecting from said cylindrical lens holder portion in a radial direction of said cylindrical lens holder portion; and

10 a pivoted cylindrical portion located on an end of said swing arm portion, and is fitted on said pivot to be rotatable thereon;

wherein the contact surface of the retractable holder comprises a projecting portion located on said swing arm portion, said projecting portion extending  
15 towards said rear holder.

10. The retracting lens barrel according to claim 1, wherein the retractable lens barrel is incorporated in a camera.

20 11. An optical element retracting mechanism for a retractable lens including an optical system having a plurality of optical elements, the optical element retracting mechanism comprising:

a linearly movable ring configured to be guided  
25 along an optical axis of said optical system without

rotating, and which retracts toward a plane along said optical axis when said retractable lens moves from an operational state to a fully-retracted state;

5 a retractable holder configured to support a retractable optical element as one of the plurality of optical elements, said retractable holder positioned inside said linearly movable ring and movable in a plane substantially orthogonal to said optical axis;

10 a holding device configured to hold said retractable holder such that the retractable optical element remains positioned along the optical axis when the retractable lens is in the operational state;

15 a retracting device configured to move said retractable holder such that said retractable optical element retracts to a radially retracted position outside of the optical axis when said linearly movable ring, together with said retractable holder, retracts toward said plane;

20 an axially retractable frame positioned behind said retractable holder when said retractable lens is in the operational state, and is movable along the optical axis of the optical system independently of said linearly movable ring, wherein at least part of said axially retractable frame enters said linearly movable ring to  
25 be positioned in a same positional range as said

retractable holder in said optical axis direction when  
said retractable lens is in said fully-retracted state;

a rear optical element as one of the plurality of  
optical elements, said rear optical element supported by  
5 said axially retractable frame; and

a pair of engageable portions which are provided on  
one and the other of said retractable holder and axially  
retractable frame, said pair of engageable portions  
contacting each other without causing contact between  
10 said retractable optical element and said rear optical  
element, when said retractable holder and the axially  
retractable frame interfere with each other.

12. The optical element retracting mechanism  
according to claim 11,

15 wherein said pair of engageable portions comprises  
a rearwardly projecting portion located on said  
retractable holder, a rearmost part positioned behind a  
rearmost part of said retractable optical element in said  
optical axis direction, and a forwardly projecting  
20 portion formed on said axially retractable frame, a  
frontmost part of said projecting portion being  
positioned in front of a frontmost part of said rear  
optical element,

wherein said forwardly projecting portion is in a  
25 plane substantially orthogonal to said optical axis to

correspond to a range of movement of said rearwardly projecting portion.

13. The optical element retracting mechanism according to claim 11, wherein said retractable holder  
5 is configured to be pivoted on a pivot positioned inside said linearly movable ring, said pivot extending substantially parallel to said optical axis.

14. The optical element retracting mechanism according to claim 13, wherein said retractable holder  
10 comprises:

a cylindrical lens holder portion configured to hold said retractable optical element;

a swing arm portion projecting from said cylindrical lens holder in a substantially radial direction of said  
15 cylindrical lens holder portion; and

a pivoted cylindrical portion located on an end of said swing arm portion, and is fitted on said pivot to be rotatable thereon,

wherein said rearwardly projecting portion  
20 projects from said swing arm portion.

15. The optical element retracting mechanism according to claim 12, wherein a front surface of said forwardly projecting portion is an inclined surface which is inclined to a plane substantially orthogonal to said  
25 optical axis, said inclined surface inclined toward the

rear of said optical axis direction in a direction of retracting movement of said retractable holder.

16. The optical element retracting mechanism according to claim 12, wherein said axially retractable  
5 frame comprises:

an accommodation portion configured to accommodate said rear optical element; and

at least one guide arm portion which extends radially outwards from said accommodation portion, and  
10 is configured to be guided linearly along said optical axis without rotating by at least one guide shaft extending substantially parallel to said optical axis,

wherein said forwardly projecting portion is a rib-like portion which projects forward from a front  
15 surface of said accommodation portion.

17. The optical element retracting mechanism according to claim 16, wherein said guide arm portion comprises a pair of guide arm portions which extend radially outwards from said accommodation portion  
20 substantially in opposite directions away from each other, and wherein said guide shaft comprises a pair of substantially parallel guide shafts configured to guide said pair of guide arm portions along said optical axis, respectively.

25 18. The optical element retracting mechanism



according to claim 12, further comprising a stationary member positioned behind said axially retractable frame, said stationary member configured to set a rear limit for movement of said axially retractable frame in said optical axis direction,

wherein said retractable holder retracts to said radially retracted position of said retractable optical element without allowing said rearwardly projecting portion to come into contact with said forwardly projecting portion, when said linearly movable ring retracts to a fully-retracted position thereof with said axially retractable frame being fully retracted to said rear limit thereof, and

wherein the rearwardly projecting portion comes into contact with said forwardly projecting portion and subsequently presses said forwardly projecting portion rearward to retract said retractable holder to said retracted position thereof, when said linearly movable ring retracts to a fully-retracted position thereof with said axially retractable frame not being fully retracted to said rear limit thereof.

19. The optical element retracting mechanism according to claim 18, further comprising a controller configured to move said axially retractable frame to said rear limit thereof before a commencement of a retracting

movement of said retractable holder.

20. The optical element retracting mechanism according to claim 18, wherein said retracting device comprises a cam provided on said stationary member and  
5 positioned along a moving path of said retractable holder in said optical axis direction when said retractable lens is in said operational state, said cam pressing said retractable holder to move said retractable holder so that said retractable optical element retracts to said  
10 radially retracted position when said linearly movable ring, together with said retractable holder, retracts toward said plane.

21. The optical element retracting mechanism according to claim 18, wherein said stationary member  
15 comprises a holder configured to hold an image pick-up device.

22. The optical element retracting mechanism according to claim 11, wherein each of said retractable optical element and said rear optical element comprises  
20 a lens group.

23. The optical element retracting mechanism according to claim 11, wherein said optical system comprises a zoom photographing optical system;

wherein said retractable optical element comprises  
25 a lens group as a part of said zoom photographing optical

system; and

wherein said rear optical element comprises a lens group as another part of said zoom photographing optical system.

5        24. The optical element retracting mechanism according to claim 11, wherein said optical element retracting mechanism is incorporated in a digital camera.

25. The optical element retracting mechanism according to claim 11, wherein an axial center of said  
10 linearly movable ring extends substantially parallel and eccentric to said optical axis.

26. The optical element retracting mechanism according to claim 11, wherein said holding device comprises a spring configured to bias said rotatable  
15 holder to move in a direction toward said optical axis.